

CTM-15X PAD OPERATION



Model	Chameleon CTM-15X Modem
Revision	Revision 1.0

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Revision Control

Description	Revision	Date
Customer Release	Revision 1.0	04-Dec-2009

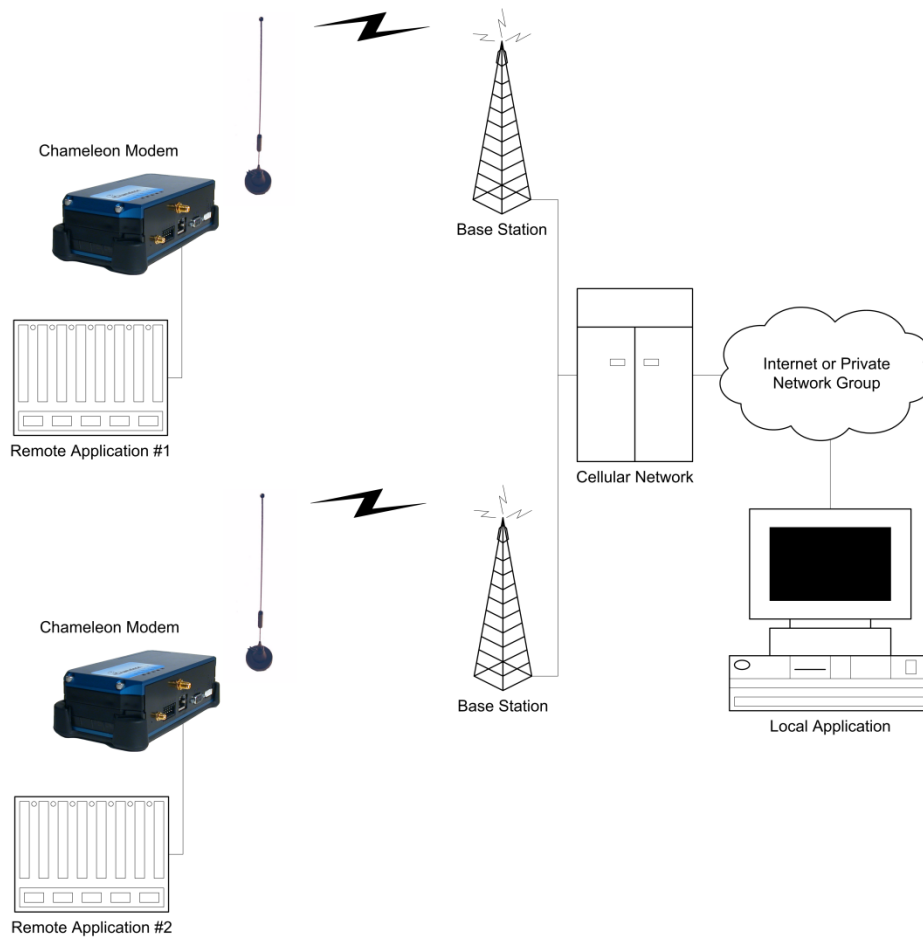
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2 CTM-15X PAD Operation

Packet Assembly and Disassembly (PAD) is used for sending and receiving “raw” data over IP networks. The modem takes care of establishing IP network connections, as well as the encapsulation of data within UDP or TCP packets. This eliminates the need for a TCP/IP stack running on the host device. This application note details how to setup a CTM-15x cellular wireless data modem in PAD mode in order to provide a communications link between a serial port end device and a central control application.

A PAD connection uses the CDMA EVDO (Rev A) or the HSPA+ packet data network providing the advantages of higher data rates for quicker response times, and always being connected. PAD mode is typically used for supervisory control and data acquisition (SCADA) applications. PAD mode can be used with master and slave devices that use proprietary communication protocols such as the Allen Bradley DF1 or used to provide direct communications with field devices normally operated on a dial-up modem connection.



x = 2 start up UDP PAD client mode - one session. The modem will revert to command mode once the connection is closed.

x = 3 start up TCP PAD client mode - one session. The modem will revert to command mode once the connection is closed.

x = 4 start up persistent UDP PAD client mode

x = 5 start up persistent TCP PAD client mode

cmd padip iii.iii.iii.iii

For server mode use 0.0.0.0 (this is the modem's default). For client mode use the IP address of the server modem, or if the host device will initiate the connection keep this as 0.0.0.0

cmd padport xxxxx

For PAD mode 0 or 1 (server modes), xxxxx is equal to the modem's PAD listening port. For all other PAD modes (client modes), xxxxx is equal to the port of the server modem. In PAD mode 0 or 1, when used as a client the modem will transmit to this port and then listen on this port when it reverts to server mode.

cmd padfwdc x

This is the PAD forwarding character. It defines which Hex value or ASCII character (in decimal) will initiate the encapsulation and transmission process. The default is ASCII character 13 (carriage return). If your protocol always ends a "sentence" with the same terminating character then it can be set here. If no forwarding character is required set this to x = 0. If x = 0, **padfwdt** or **padfwdl** will invoke sending the packet.

cmd padfwdl x

This is the PAD forwarding length (default x = 40). It defines how many characters will initiate the encapsulation and transmission process. Generally this parameter is set to a value greater than the longest "sentence" in your protocol. If no forwarding length is required set this to maximum (1000). If x = 0 is specified then every character is sent immediately.

cmd padfwdt x

This is the PAD forwarding time in 50 ms increments. It defines the time after receiving the last character in a "sentence" that the encapsulation and transmission process will be initiated. If every character is required to be sent immediately then set n = 0.

cmd padecho x

If the connected device requires every character it sends to the modem to be echoed back on the serial port then set n = 1. Otherwise, set n = 0 to disable the echo feature.

cmd padsvct n [c]

The n parameter sets the server connect timeout in seconds (default n = 15). The c parameter (optional) sets the maximum PAD connection timer in seconds (default c = 0, disabled). If the modem is configured using **cmd padmode 0/1**, it starts as a client

then after n seconds reverts to server mode in order to receive incoming connections from another client. If the modem is required to be always in client mode then use **cmd padmode 4/5** while setting n = 0, c = 0 to disable the timers.

cmd save

Save the current settings to non-volatile memory. When **cmd mode 4** is saved, the modem will now always power up in auto connect, PAD mode with the settings as configured above.

cmd pwrmode 2

Power cycling the modem will initiate the PAD connect for **cmd mode 4**.

cmd padreset

Drop the current PAD connection and perform the following:

padmode 0/1: return to server mode

padmode 2/3: return to serial command console

padmode 4/5: establish new PAD connection

This command allows manual triggering of the equivalent actions that occur on when one of the **padsvct** timers expire.

3.1 Initiating a PAD connection from the modem

If the modem has been configured in **cmd mode 4** (auto connect to network and PAD host interface) then after a power cycle no other action is required to initiate the connection.

If the modem has been configured in **cmd mode 2** (auto connect to network) then it will be necessary to initiate the PAD connection using a command:

cmd pad

Use this if **cmd padip** and **cmd padport** have been previously configured. If **cmd padip 0.0.0.0** has been configured then the modem will connect in server mode and listen on the port defined by **cmd padport**. If **cmd padip iii.iii.iii.iii** has been configured with a non-zero IP address then the modem will connect to that IP address in client mode and transmit to the port defined by **cmd padport**.

Note that it is the client end that has to initiate the connection – the server is simply waiting to accept an incoming connection.

3.2 Closing a PAD connection

Closing a PAD connection can be done in various ways:

Send the escape sequence to the serial port (the default escape sequence is **+++**) – note that no “Enter” is required as part of the escape sequence. The modem will drop into command mode. The escape sequence may be changed using the command **cmd padesc <string>**. Note the PAD escape guard timer is set using the **cmd padesct n** command.

When the modem has been previously configured for PAD client mode - one session (**cmd padmode 2** or **cmd padmode 3**), using the command **cmd padreset** will cause the PAD connection to drop and the modem will go into the serial console.

The **cmd padsvct** server connection timer will expire after a period of inactivity equal to its setting (default 15 seconds). When the modem has been configured with **cmd padmode 0/1** and **cmd padip** using a valid IP address, and is in client mode for the first time, once this timer expires the modem will go into server mode. The **cmd padsvct** maximum connection timer will expire after a period equal to its setting, regardless of the PAD data connection condition (default 0 seconds, meaning disabled).

On TCP PAD connections if the server end drops the connection then a modem configured with **cmd mode 4** (auto connect to network and PAD) and **cmd padmode 5** (auto connect TCP PAD client) will attempt to reconnect the TCP session.

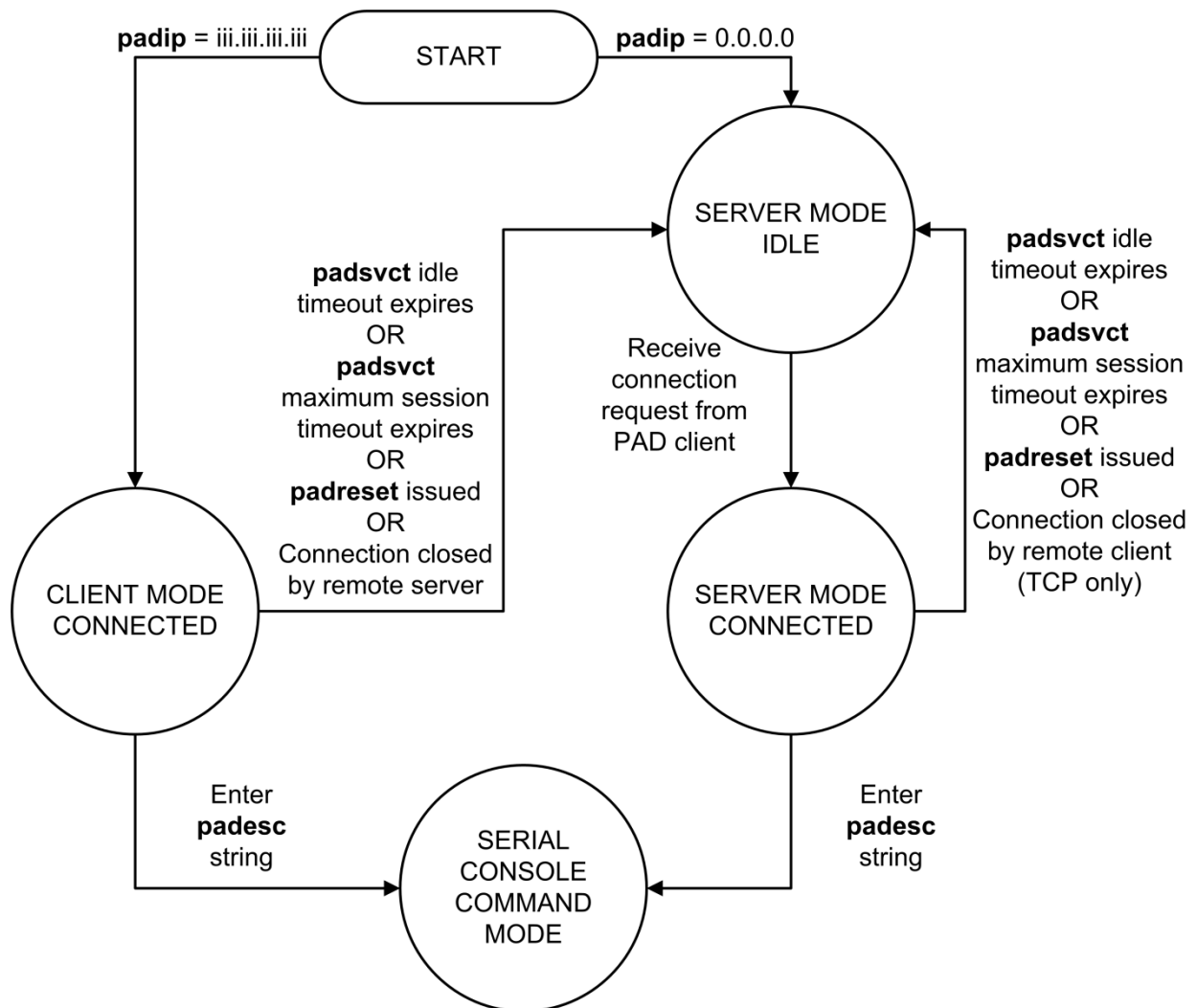
4 State Diagrams for PAD operation modes

The following section provides the state diagrams that describe PAD operation for each of its modes:

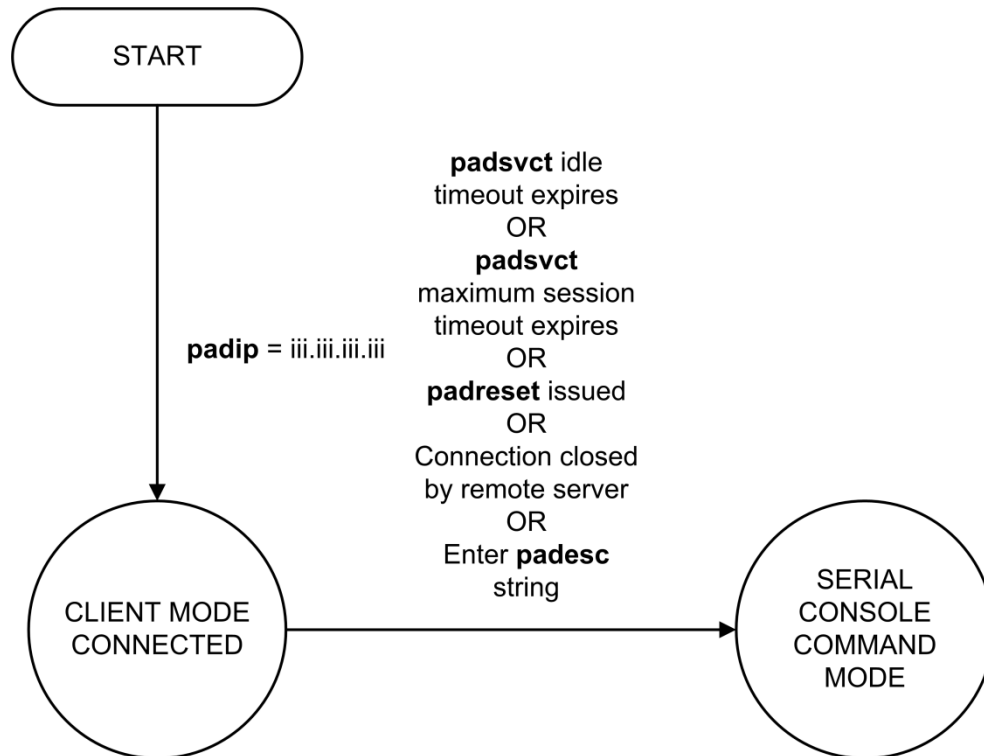
- PAD server mode: **cmd padmode 0** (UDP), **cmd padmode 1** (TCP)
- PAD client, single-session mode: **cmd padmode 2** (UDP), **cmd padmode 3** (TCP)
- PAD client, persistent mode: **cmd padmode 4** (UDP), **cmd padmode 5** (TCP)

In the state diagrams below, the circles indicate the current state of PAD and the arrows exiting the circles indicate events which cause PAD to change its state.

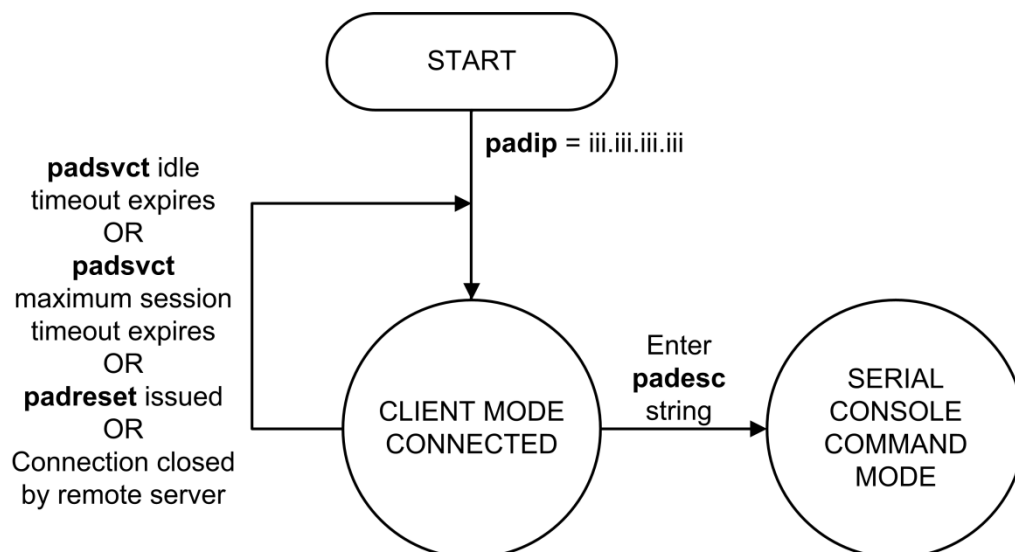
4.1 PAD Server Modes (padmode 0/1)



4.2 PAD Client Single Session Modes (padmode 2/3)



4.3 PAD Client Persistent Mode (padmode 4/5)

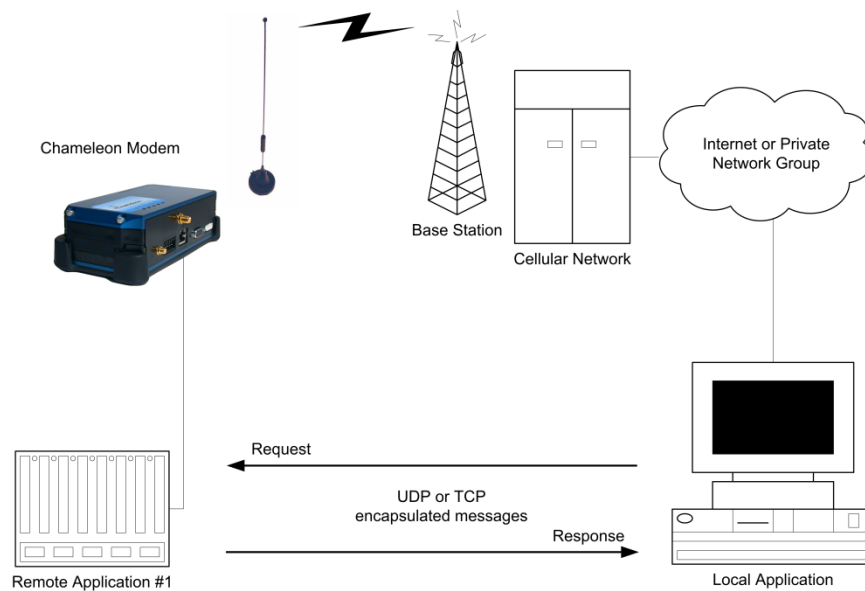


5 Example Modem PAD Configuration

5.1 Modem PAD Configuration for a SCADA Field Device in Slave Mode

In this example, a Chameleon modem is connected to a SCADA field device which is polled by a remote server. The field device in slave mode is either connected to another Chameleon modem or has built-in TCP/IP functionality. The field device communicates with a remote server or master device via a request/response protocol. The slave devices will only send responses to requests sent.

The device connected to the modem's serial port is operating at 9600 baud with no hardware flow control (Tx, Rx, & Gnd signals only), and responds to every incoming sentence with a reply of maximum length 50 bytes of ASCII data always terminated with the character <. The serial slave device does not support echoing of data that it sends to the modem. The chosen listening port is 5000.



Enter the following commands from the serial console of the modem connected to the serial slave device:

cmd factory

cmd mode 4

cmd port 9600 8 n 1 0

It will now be necessary to adjust the baud rate of the terminal application to 9600.

cmd padmode 0/1 PAD server mode: 0 = UDP, 1 = TCP

cmd padecho 0 Do not echo data sent by the slave device back on the serial port

cmd padip 0.0.0.0 Sets PAD to server mode only (default settings, in effect after **cmd factory**)

cmd padport 5000 Sets port on which field device will be listening for requests

cmd padfwdc 60 Decimal value of ASCII <

cmd padfwdl 51 Greater than longest message size

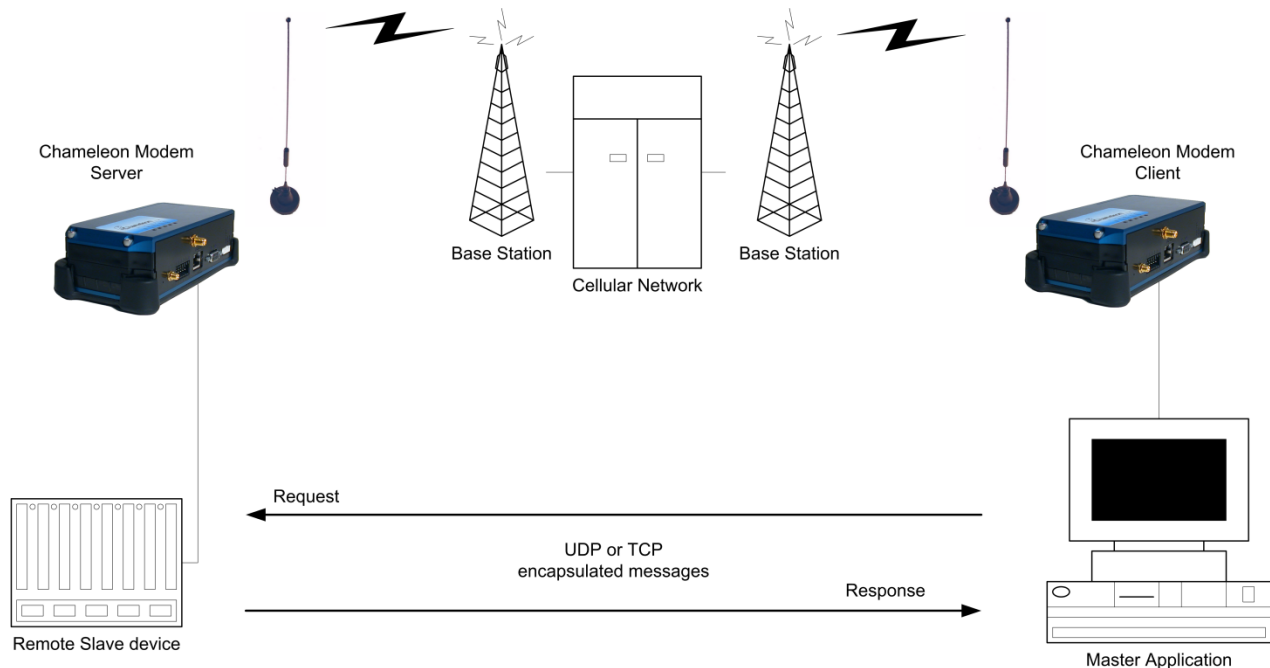
cmd padfwdt 20 Sets the forwarding time to 1 second idle period (default setting, in effect after **cmd factory**)

cmd padsvct 15 0	Set connection timeout to 15 seconds, maximum connection timer is disabled (default settings, in effect after cmd factory)
cmd save	Save configuration to modem's non-volatile memory
cmd pwrmode 2	Power cycle

5.2 Modem PAD Configuration for a SCADA Master Device Polling a Single Field Device in Slave Mode

In this example, a Chameleon modem is connected to a master device which polls data from a single field device in slave mode. The field slave device is either connected to another Chameleon modem or has built-in TCP/IP functionality. The master device is typically a server running a SCADA application and communicates with the field device via a request/response protocol. The slave devices will only send responses to requests sent.

The modem connected to a master device operates at a baud rate of 19200 with full hardware flow control. The master device receives sentences on its serial port of maximum length 100 bytes (with no common end character) which are to be sent to a single slave unit at IP address 100.100.1.2, port 5000. The serial master device requires echoing of data that it sends to modem.



For the modem connected to the serial master device, enter the following commands from the serial console:

cmd factory
cmd mode 4

cmd port 19200 8 n 1 2

It will now be necessary to adjust the baud rate of the terminal application to 19200.

cmd padmode 4/5 PAD client, persistent mode: 4 = UDP, 5 = TCP

cmd padecho 1 Echo data sent by the master device back on the serial port
(default setting, in effect after **cmd factory**)

cmd padip 100.100.1.2 Sets IP address of field device being polled

cmd padport 5000 Sets port of field device being polled

cmd padfwdc 0 No forwarding character

cmd padfwdl 101 Greater than longest message size

cmd padfwdt 10 Sets the forwarding time to 0.5 seconds idle period

cmd padsvct 15 0 Set connection timeout to 15 seconds, maximum connection timer is disabled
(default settings, in effect after **cmd factory**)

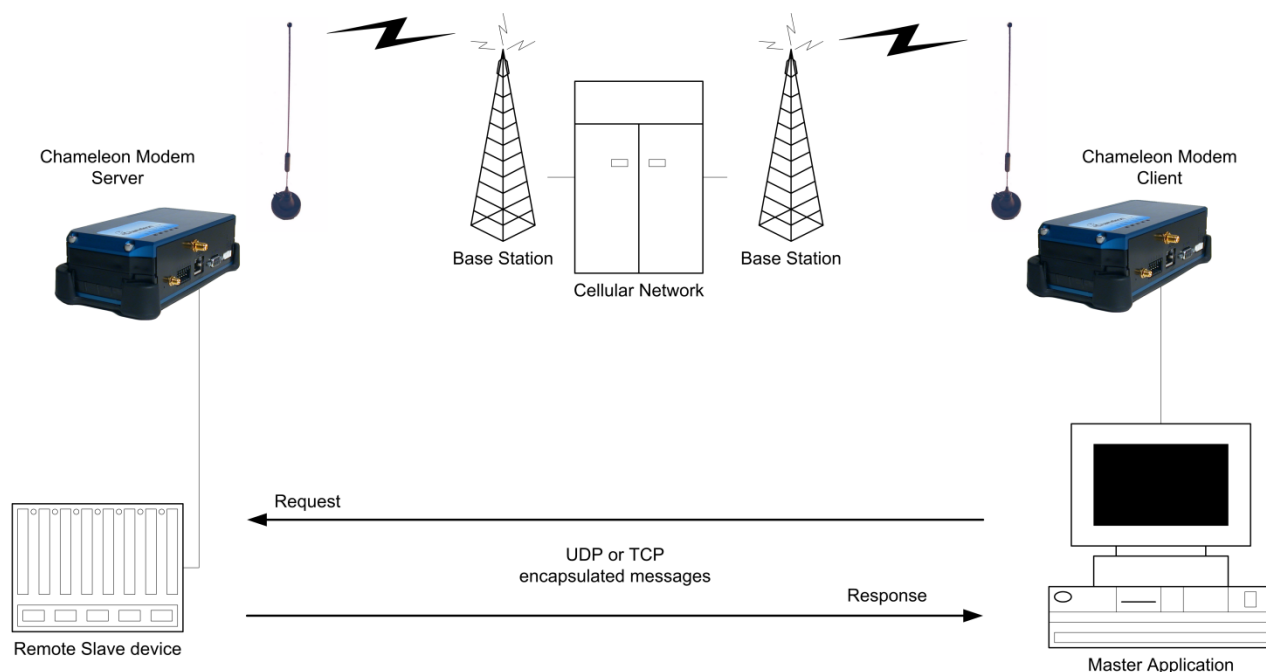
cmd save Save configuration to modem's non-volatile memory

cmd pwrmode 2 Power cycle

5.3 Modem PAD Configuration for a SCADA Master Device Polling Multiple Field Devices in Slave Mode

In this example, a Chameleon modem is connected to a programmable master device intended to poll multiple field devices in slave mode. The master device is typically a server running a custom SCADA application and communicates with field devices via a request/response protocol. The slave devices will only send responses to requests sent.

The modem is connected to a master device at baud rate of 19200 with full hardware flow control. It receives sentences on its serial port of maximum length 100 bytes (with no common end character) which are to be sent to multiple slave units at IP addresses 100.100.1.1-100.100.1.10, port 5000. The slave devices typically respond within 8 seconds. The serial master device requires echoing of data that it sends to the modem. In this example, the master device requires built-in scripting functionality to perform predefined actions based on serial port output when in command mode.



Enter the following commands from the serial console of the modem connected to the serial master device:

cmd factory

cmd mode 2

cmd port 19200 8 n 1 2

It will now be necessary to adjust the baud rate of the terminal application to 19200.

cmd padmode 2/3 PAD client, single-session mode: 2 = UDP, 3 = TCP

cmd padecho 1 Echo data sent by the master device back on the serial port (default setting, in effect after **cmd factory**)

cmd padfwdc 0 No forwarding character

cmd padfwdl 101 Greater than longest message size

cmd padfwdt 100 Sets the forwarding time to 5 seconds idle period

cmd padsvct 10 0 Set connection timeout to 10 seconds, maximum connection timer disabled

cmd save Save configuration to modem's non-volatile memory

cmd pwrmode 2 Power cycle

In command mode, for each request to a specific slave device, the master device should send the following commands:

cmd padip 100.100.1.1 Sent by master device to set new PAD slave to which to connect

cmd pad Sent by master device to start new PAD connection

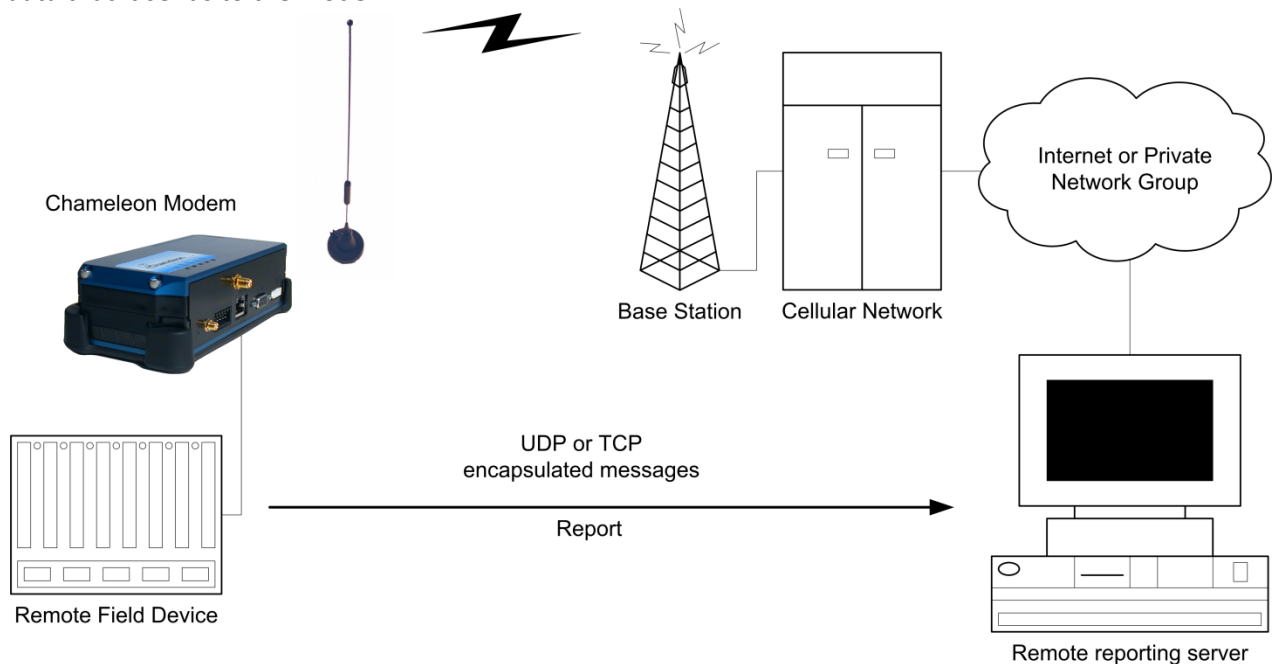
Upon executing **cmd pad**, the modem will connect to the PAD slave with IP address **100.100.1.1** as specified in **cmd padip**, transmit a request, and disconnect if the connection idle time is 10 s, or if the escape sequence is entered on the serial port (default is +++). Once disconnected, the modem will drop into command mode. Repeat **cmd padip** and **cmd pad** for other slave devices using IP addresses **100.100.1.2-100.100.1.10**.

In this example, the master device requires some scripting or programmable functionality to perform the following actions iteratively for polling data from slave devices:

1. Detect the modem's command mode by checking that the pound character (#) is received on the serial port
2. Execute **cmd padip** using the field device's IP address
3. Execute **cmd padport** using the field device's port
4. Execute **cmd pad** to start PAD operation
5. Send the current field device request over the serial port
6. Wait for the response from the field device. In this example, the modem should drop back into command mode after 10 seconds.

5.4 Modem PAD Configuration for a Reporting Field Device

In this example, a Chameleon modem is connected to a field device that reports to a remote server without the need to be polled. The field device generates data on the serial port whenever it is available and the modem will send this data remotely over-the-air. The remote field device operates at a baud rate of 9600 and uses hardware flow control. The field device generates ASCII data with varying length and is always terminated with the carriage return character <CR>. The field device does not require echoing of data that it sends to the modem.



For the modem connected to the reporting field device, enter the following commands from the serial console:

```
cmd factory
cmd mode 4
cmd port 9600 8 n 1 2
```

It will now be necessary to adjust the baud rate of the terminal application to 9600.

cmd padmode 4/5	PAD client, persistent mode: 4 = UDP, 5 = TCP
cmd padip 200.100.1.1	Sets IP address of remote server handling data reported by the field device
cmd padport 8000	Sets port to which data is to be sent
cmd padecho 0	Do not echo data sent by the field device back on the serial port
cmd padfwdc 13	Decimal value of ASCII <CR> (default setting, in effect after cmd factory)
cmd padfwdl 40	Data to be sent over the air in 40-byte packets or less if <CR> in first 40 bytes (default setting, in effect after cmd factory)
cmd padfwdt 20	Sets the forwarding time to 1 second idle period (default setting, in effect after cmd factory)
cmd padsvct 15 0	Set connection timeout to 15 seconds, maximum connection timer is disabled (default settings, in effect after cmd factory)
cmd save	Save configuration to modem's non-volatile memory
cmd pwrmode 2	Power cycle

6 Technical Support/Warranty

**Cypress Solutions Service
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